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CLES-ICT: a Scale to measure ICT Constructivist Learning Environments in Malaysia

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Abstract

The purpose of this study was to validate an instrument to explore students' preferences toward the constructivist learning environments for a discrete ICT subject. The instrument was customized and modified from the Constructivist Learning Environment Survey (CLES) questionnaire. It included five components of constructivist learning: Personal Relevance, Uncertainty of ICT, Shared Control, Critical Voice and Student Negotiation. Data were gathered from 440 Malaysian secondary school students. Data analyses supported the instrument's internal consistency reliability, factor structure, discriminant validity and its ability to differentiate between ICT classrooms.

Keywords: constructivist learning environments; constructivist learning; ICT; ICT classrooms; Malaysia

1. Introduction

Constructivism has attained a leading theoretical position in education and has become a powerful driving force in ICT education (Norum et al., 1999, Coombs & Wong, 2000; Hirumi, 2002, Neo and Neo, 2002; Neo, 2003). In the constructivist learning environment, learners are expected to acquire new experiences and fit these new experiences into their lives to make sense of the environment (Shelly, Cashman, Gunter & Gunter, 2004). Learning is seen as an active process wherein learners construct new ideas based on their current or past knowledge (Shelly et al., 2004). Apart from the change in student's role, the teacher is also expected to cease from their role of a content expert to a facilitator. However, Airasian and Welsh (1997) believed that the change will not be easy as teachers

> will have to learn to guide, not tell; to create environments in which students can make their own meanings, not be handed them by the teacher; to accept diversity in constructions, not search for "right" answer; to modify prior notions of "right" and "wrong," not stick to rigid standards and criteria; to create a safe, free, responsive environment that encourages disclosure of student constructions, not closed, judgmental system (p.448).

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To sum up, the teacher's role changes from that of the sole authority and a sage on the stage to that of a guide at the side and a facilitator (Rakes, 1996; Cifuentes, 1997). At the same time, the student's role shifts from being a passive and dependent learner to being an active and independent learner (Hirumi, 2002; Coombs & Wong, 2000). Indeed, the changes in both the teachers and students' roles and how teaching approaches are employed in the classrooms, have sparked the interests of many researchers seeking to investigate the constructivist learning environments. Exploring students' perceptions toward constructivist learning environments is seen as crucial, even more so for the Malaysian education system because of the introduction of the ICT subject in secondary schools. This move would enable ICT teachers to improve and enhance the ICT constructivist learning environment in Malaysian secondary schools. For this reason, there is an urgent need to help teachers assess if their teaching and learning practices are in accordance with the constructivist perspective.

2. Objective of the Study

The objective of this study was to validate a scale to measure Malaysian school students' perceptions toward constructivist ICT learning environments. The researchers decided to use a modified version of the actual form of CLES which was renamed the Constructivist Learning Environment for ICT (CLES-ICT) for the present.

3. Methodology

3.1. Subjects and Procedures

Participants of this study were secondary school students in the Klang Valley. This location has the highest concentration of secondary schools in Malaysia offering the ICT subject as an elective. For each randomly selected school, the researchers obtained the cooperation of the ICT teachers in the respective school to administer the questionnaires. A total of completed 440 questionnaires were received from 243 female and 197 male students. They had an average of 4.90 years of computer experience (S.D.= 3.03) and their mean age was 15.99 years old (S.D.= 0.257). The majority of the students owned a personal computer (79.8%) at home. Data from these students who responded to the questionnaire fully were analysed to check for construct validity, internal consistency of the scales and discriminant validity.

3.2. Instrumentation

The items were adapted from the CLES and translated into the Malay Language with permission from Dr Peter Taylor. For CLES, Taylor proposed the following five subscales of personal relevance (*Example item: In this ICT class, I learn about the world outside of school*), uncertainty (*Example item: In this ICT class, I learn that ICT has changed over time*), critical voice (*Example item: In this ICT class, it's OK for me to ask the teacher "why do I have to learn this?"*), shared control (*Example item: In this ICT class, I help the teacher to plan what I'm going to learn*) and student negotiation (*Example item: In this ICT class, I get the chance to talk to other students*)which made of 25 items for CLES. The items developed in this study were based on these items. The researchers changed the term 'Science' into 'ICT'. This means that each item in CLES was modified to measure students' perceptions toward the constructivist learning environments specifically for ICT instead of science. This questionnaire was called the Constructivist Learning Environment Survey for ICT (CLES-ICT). The items were measured by a five point Likert-type scale, ranging from almost never (1), seldom (2), sometimes (3), often (4) to almost always (5). Hence the numerical responses indicate the secondary school students' perceptions about the degree or frequency that the stated practices occur or are experienced.

The definitions of the five subscales in CLESICT stem from the original definitions proposed by Taylor et al. (1997) but minor changes were made, in particular to the subscale, uncertainty, in accordance to the Malaysian ICT syllabus. A detailed description of the five subscales is presented below:

1. Personal Relevance (PR) - extent to which secondary school students are able to relate ICT with their out of school experiences;
2. Uncertainty of ICT (U) - extent to which opportunities are created for secondary school students to experience ICT knowledge involving human experience and values, and as evolving, non-foundational, and culturally and socially determined);

3. Critical Voice (CV) - extent to which a social climate has been established in which secondary school students feel that it is legitimate and beneficial to question the teachers' pedagogical plans and methods and to express concerns about any impediments to their learning);
4. Shared Control (SC) - extent to which secondary school students are invited to share with their teacher control of the learning environment, including the articulation of their own learning goals, design and management of their learning activities and determining and applying assessment criteria;
5. Student Negotiation (SN) - extent to which opportunities exist for secondary school students to explain and justify to other students their newly developing ideas and to listen and reflect on the viability of other students' ideas.

3.3. Validation and pilot test

One of the authors of this paper content validated all the items in the questionnaire. The items were also checked for clarity. The item "I learn that ICT is influenced by people's values and opinions" was split into two separate items because it was double barrelled in nature. The single item was changed into "I learn that ICT is influenced by people's value" and "I learn that ICT is influenced by people's opinion". A qualified person with vast experience in the field of computer technology but not involved in the research was also asked to validate the items. After discussion, the item "I learn that ICT involves inventing theories" was found to be inappropriate for the Malaysian ICT syllabus. The item was removed from the questionnaire. Apart from that, both content validators found the items to be suitable in the Malaysian context. Five teachers who were in their final year of study in the programme, Bachelor of Education majoring in ICT were also asked to help establish face validity of the items. All five unanimously agreed that the items were suitable for the Malaysian context.

A double back translation was carried out on items to ensure that the items in the Malay Language were equivalent to the original English version. Three bilingual schoolteachers were involved in the translation process. The first teacher translated the original English version into Malay. The second teacher then retranslated the Malay version into English without looking at the original version. Finally, the third teacher compared the original and the translated English versions. The teacher agreed that the meanings of both versions were consistent and each statement retained its original meaning. The instrument was pilot tested on a group of students who took the ICT subject as an elective. They were not included in the actual study. All thirty respondents answered the items fully. The Cronbach's alpha reliability coefficient was used as the index of scale internal consistency. The values recorded for all subscales ranged from moderate (Critical Voice - .73) to good (Shared Control - .91, Student Negotiation - .80) except for two subscales (Personal Relevance - .54, Uncertainty - .50).

Based on these results, ten students were randomly selected and interviewed to assess if they actually understood and had responded to the items on the basis intended by the researchers. Eight out of ten students misinterpreted that the items also measured other ICT integrated learning environments for subjects such as Mathematics and Science as they had failed to read the prompt ("In this ICT class") placed at the beginning of the each subscale. Based on these feedbacks, the format of the items was changed where the prompt "In this ICT class" was inserted into every item. The 25 items of the five subscales are shown in Appendix A.

4. Data Analysis

4.1. Factor analysis

The 25 items of CLESICT were subjected to Principal Components Analysis (PCA). Items with factor loading greater or equal to the conventionally accepted value of 0.30 were retained. Prior to performing PCA, the suitability of both sets of data for factor analysis was assessed. The Kaiser-Meyer-Olkin measure of sampling adequacy was .851. The values indicated that none of the items violated the assumption of no multicollinearity. Because the Bartlett's Test of Sphericity was significant ($p < .001$), it supported the factorability of the correlation matrix.

The decision on the number of factors to extract was based on the scree test and latent root criterion as recommended by Hair, Anderson, Tatham and Black (1992). Eigen values greater than one were accepted for the latent root criterion. The latent root criterion with a cut-off value of 1.0 for the eigen values suggested seven factors should be retained after running PCA. All seven factors were found to have eigen values greater than one, accounting for 60.82% of the variance in the item responses.

An inspection of the screeplot obtained seemed to suggest a break after the fifth component. Using Catell's (1966) scree test, it was decided to retain five components for further investigation. To aid in the interpretation of

these five components, Varimax rotation was performed. Table 1 shows the factor loadings obtained for the sample of 440 students in 19 schools. The five factor solution explained a total of 53.81% of the variance, with Component 1 contributing 10.41%, Component 2 contributing 4.67%, Component 3 contributing 6.30%, Component 4 contributing 25.04% and lastly Component 5 contributing 7.39%. The interpretation of the five components was consistent with previous research of the original CLES, with Personal Relevance items loading strongly on Component 1, Uncertainty items loading strongly on Component 2, Critical Voice items loading strongly on Component 3, Shared Control items loading strongly on Component 4 and Student Negotiation items loading strongly on Component 5.

Table 1: Item factor loadings for CLES-ICT

	Factor Loadings								
Item	**Personal Relevance**	**Item**	**Uncertainty**	**Item**	**Personal Relevance**	**Item**	**Shared Control**	**Item**	**Student Negotiation**
Q1	.762	Q6	.403	Q11	.587	Q16	.737	Q21	.506
Q2	.666	Q7	.692	Q12	.652	Q17	.614	Q22	.703
Q3	.686	Q8	.716	Q13	.807	Q18	.769	Q23	.756
Q4	.702	Q9	.616	Q14	.758	Q19	.763	Q24	.659
Q5	.672	Q10	.384	Q15	.497	Q20	.756	Q25	.665

4.2. Internal Consistency Reliability and Ability to Differentiate between Classrooms

The internal consistency of each scale was determined through Cronbach's alpha coefficient using the individual student as the unit of analysis. Table 3 shows that the reliability estimate for each scale ranged from .64 to .86. This suggests that all scales of CLES-ICT possess satisfactory internal consistency. It is important to highlight here that the value range of the present study, and the fact that the Uncertain scale recorded the lowest reliability, is almost similar as those reported by Taylor et al. (1997) and Kim et al. (1999). According to Kim et al. (1999), the actual form of a classroom environment scale should be capable of differentiating among student's perceptions from different classrooms. In other words, students within the same class should perceive it relatively similarly while average class perceptions should vary among various classes. A one-way ANOVA was conducted for this purpose. Table 2 shows that each CLESICT scale differentiated significantly between classes and the eta^2 statistic (the amount of variance accounted for by class membership) ranged from 0.08 to 0.12. These figures are relatively small and indicate that the ICT learning environment in Malaysia is quite similar.

4.3. Correlations among Subscales

The discriminant validity of each scale of the instrument was determined through Pearson's correlation. In this research, the five sub-scales of CLESICT were considered as five different measures of the ICT constructivist learning environment. Table 3 comprises the correlation matrix for item scores of each subscale which shows the inter-correlations among the sub scales' scores. The correlations of one scale and the other four subscales ranged from .255 to .518. These Pearson's r values can be regarded as small enough to establish the discriminant validity of the CLESICT, indicating that each sub-scale measures distinct, although somewhat overlapping, aspects of the ICT constructivist learning environment.

Table 2: Internal consistency reliability and ability to differentiate between classrooms

Scale	**Cronbach's alpha**	**ANOVA eta^2**
Personal Relevance	.79	0.11**
Uncertainty	.64	0.08*
Critical Voice	.76	0.11**
Shared Control	.86	0.12**
Student Negotiation	.73	0.12**

**p<0.01, *p<0.05

Table 3: Pearson product moment correlation of CLESICT

		1	2	3	4	5
1.	**Personal Relevance**	1.00	.518**	.255**	.310**	.332**
2.	**Uncertainty of ICT**		1.00	.296**	.290**	.324**
3.	**Critical Voice**			1.00	.492**	.305**
4.	**Shared Control**				1.00	.312**
5.	**Student Negotiation**					1.00

** Correlation is significant at the 0.01 level (2-tailed)

5. Discussion and Conclusion

The reliability estimates were uniformly high and surpassed the minimal consistency guidelines (>.70) recommended by DeVellis (1991) except for the uncertainty subscale. It is noteworthy that the Cronbach's alpha reported for this subscale is almost similar as those reported by Taylor et al. (1997) and Kim et al. (1999) in the original CLES. It could be assumed that the reliability estimates exhibited in this study proved that the instrument had good internal consistency. The PCA confirmed that five distinct subscales exist as underlying constructs of CLESICT. This explains the significant correlations that exist between the five factors. All items retained in the CLESICT exhibited from moderate to high structure coefficients (> .30). The moderate and significant relationships among the three subscales as well as the moderately high structure coefficients in the PCA strongly indicate that the five subscales share a large amount of common variance. Gressard and Loyd (1986) stated that with such correlation and structure coefficients, the total summation of the five scores can be reasonably interpreted to represent students' perceptions toward the ICT constructivist learning environment. To conclude, the researchers are confident that CLESICT can provide a statistically reliable and valid measure of students' perceptions toward ICT constructivist learning environment. In addition, the instrument was developed in the Malay Language, made it possible for students to fully understand the entire instrument.

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